CLAIMS

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- 3 [001] A method for controlling a brushless DC motor (1)
- 4 comprising the steps which are repeated cyclically: adjusting
- 5 a desired speed of the motor (1) by varying an average
- 6 terminal voltage of the motor; detecting the average power
- 7 requirement (P) of the motor (1) and the lead angle (θ)
- 8 between the rotor of the motor and the driving magnetic
- 9 field, approximating the lead angle (θ) to a desired value
- 10 given as a function of the speed (U) and the average power
- 11 requirement (P).

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- 13 [002] The method according to claim 1, characterised in that
- the desired value is that value of the lead angle (θ) which
- maximises the efficiency (η) of the motor (1) for the
- 16 allocated values of the speed and average power requirement.

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- 18 [003] The method according to claim 3, characterised in that
- 19 the desired value of the lead angle is determined from a
- 20 characteristic map (K) which specifies the lead angle with
- 21 the highest efficiency for a plurality of operating points of
- 22 the motor each defined by a speed and an average power
- 23 requirement.

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- 25 [004] The method according to claim 3, characterised in that
- 26 the desired value of the lead angle for the actual speed and
- 27 the average power requirement is obtained from the
- 28 characteristic map by interpolation.

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- 30 [005] The method according to any one of the preceding
- 31 claims, characterised in that in step a) the average terminal
- 32 power of the motor is varied by pulse width modulation.

- 1 [006] A control device for a brushless DC motor (1)
- 2 comprising an AC/DC inverter (7) supplied by an intermediate
- 3 direct voltage circuit (+, -) for feeding the DC motor (1), a
- 4 pattern generator (3, 5, 6, 8-23) for controlling the
- 5 switches (SU1, SU2, SV1, SV2, SW1, SW2) of the AC/DC inverter
- 6 having a periodic switching signal pattern of variable
- 7 frequency and phase, which has an input for a representative
- 8 signal for an instantaneous phase position of the rotor of
- 9 the DC motor (1), characterised in that the pattern generator
- 10 has means (22, 21) for detecting the average current strength
- 11 delivered by the AC/DC inverter and means (3, 5, 8-23) for
- 12 adjusting a phase offset (lead angle) between the phase
- 13 position of the rotor and the switching signal pattern
- 14 depending on the detected average current strength and the
- speed of the motor (1).

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- 17 [007] The control device according to claim 6, characterised
- in that this has means (21-23) for regulating an average
- 19 terminal voltage of the motor (1) using a desired speed.
- 21 [008] The control device according to claim 6 or claim 7,
- 22 characterised in that the means (3, 5, 8-23) for adjusting
- 23 the phase offset comprise a PLL circuit (3, 5, 8-20) which
- 24 can be locked to the frequency of the input signal
- 25 representative for the phase position of the rotor.
- 27 [009] The control device according to claim 6, 7 or 8,
- 28 characterised in that the means (3, 5, 8-23) for adjusting
- 29 the phase offset comprise control means (21, 23) for
- 30 predefining a target phase offset depending on the detected
- 31 power and speed of the motor.
- 33 [010] The control device according to claim 9, characterised
- 34 in that the control means (21, 23) comprise a storage device

- 1 (23) for the characteristic map of the motor (1), which
- 2 specifies for combinations of motor speed and power,
- 3 respectively one target phase offset which minimises the
- 4 power requirement of the motor (1).

- 6 [011] The control device according to any one of claims 6 to
- 7 10, characterised in that the means (3, 5, 8-23) for
- 8 adjusting the phase offset comprise means (21) for deriving
- 9 the speed from the input signal representative for the phase
- 10 position of the rotor.

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- 12 [012] The control device according to any one of claims 6 to
- 13 11, characterised in that the means for adjusting the phase
- offset comprise a desired value transmitter (21, 23) for
- 15 generating a representative signal for a desired value of the
- 16 phase offset and a regulator (3, 5, 8-20) for matching the
- 17 actual phase offset to the desired value using the
- 18 representative signal, wherein the representative signal can
- 19 have values above and below a representative value for a
- 20 phase offset of 0° .

NEW CLAIMS

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- 4 1. A method for controlling a brushless DC motor (1)
- 5 comprising the iteratively repeated steps for adjusting the
- 6 operating point of the motor (1) for a predetermined desired
- 7 speed: adjusting the speed of the motor (1) to the value of
- 8 the desired speed by varying an average terminal voltage of
- 9 the motor (1), wherein the average terminal voltage of the
- 10 motor (1) is determined by pulse width modulation; detecting
- 11 the average power requirement (P) of the motor (1) and the
- lead angle (θ) between the rotor of the motor and the driving
- magnetic field; approximating the lead angle (θ) to a
- 14 predetermined desired value as a function of the speed (U)
- 15 and the average power requirement (P).

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- 17 2. The method according to claim 1, characterised in that
- the desired value is that value of the lead angle (θ) which
- 19 maximises the efficiency (η) of the motor (1) for the
- 20 allocated values of the speed and average power requirement.

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- 22 3. The method according to claim 3, characterised in that
- 23 the desired value of the lead angle is determined from a
- 24 characteristic map (K) which specifies the lead angle with
- 25 the highest efficiency for a plurality of operating points of
- 26 the motor each defined by a speed and an average power
- 27 requirement.

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- 29 4. The method according to claim 3, characterised in that
- 30 the desired value of the lead angle for the actual speed and
- 31 the average power requirement is obtained from the
- 32 characteristic map by interpolation.

- 1 5. A control device for a brushless DC motor (1) comprising
- 2 an AC/DC inverter (7) supplied by an intermediate direct
- 3 voltage circuit (+, -) for feeding the DC motor (1), a
- 4 pattern generator (3, 5, 6, 8-23) for controlling the
- 5 switches (SU1, SU2, SV1, SV2, SW1, SW2) of the AC/DC inverter
- 6 having a periodic switching signal pattern of variable
- 7 frequency and phase, which has an input for a representative
- 8 signal for an instantaneous phase position of the rotor of
- 9 the DC motor (1), characterised in that the pattern generator
- 10 has means (22, 21) for detecting the average current strength
- 11 delivered by the AC/DC inverter and means (3, 5, 8-23) for
- 12 adjusting a lead angle between the phase position of the
- 13 rotor and the switching signal pattern depending on the
- 14 detected average current strength and the speed of the motor
- 15 (1), that the control device has means (21-23) for regulating
- 16 an average terminal voltage of the motor (1) using a desired
- 17 speed, and that the control device is designed to carry out
- the method according to any one of claims 1 to 4.
- 20 6. The control device according to claim 5, characterised in
- 21 that the means (3, 5, 8-23) for adjusting the lead angle
- 22 comprise a PLL circuit (3, 5, 8-20) which can be locked to
- 23 the frequency of the input signal representative for the
- 24 phase position of the rotor.

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- 26 7. The control device according to claim 5 or claim 6,
- 27 characterised in that the means (3, 5, 8-23) for adjusting
- the lead angle comprise control means (21, 23) for
- 29 predefining a desired value of the lead angle depending on
- 30 the detected power and speed of the motor.
- 32 8. The control device according to claim 7, characterised in
- 33 that the control means (21, 23) comprise a storage device
- 34 (23) for the characteristic map of the motor (1), which

- 1 specifies for combinations of motor speed and power,
- 2 respectively one desired value of the lead angle which
- 3 minimises the power requirement of the motor (1).

- 5 9. The control device according to any one of claims 5 to 8,
- 6 characterised in that the means (3, 5, 8-23) for adjusting
- 7 the lead angle comprise means (21) for deriving the speed
- 8 from the input signal representative for the phase position
- 9 of the rotor.

- 11 10. The control device according to any one of claims 5 to
- 12 9, characterised in that the means for adjusting the lead
- angle comprise a desired value transmitter (21, 23) for
- 14 generating a representative signal for a desired value of the
- lead angle and a regulator (3, 5, 8-20) for matching the
- 16 actual lead angle to the desired value using the
- 17 representative signal, wherein the representative signal can
- 18 have values above and below a representative value for a lead
- 19 angle of 0° .